

SHORT COMMUNICATIONS

J. Raptor Res. 22(4):116-117

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MALE-BIASED SEX RATIO IN CAPTIVE-BRED HARRIS' HAWKS

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The Harris' Hawk (*Parabuteo unicinctus*) is one of the few North American raptors in which the breeding unit often contains more than a mated pair. Breeding trios consisting of two males and a female are frequently seen (Mader 1975a, 1975b, 1979; Bednarz 1987), and simultaneous polyandry has been observed on a few occasions (Mader 1979). In wild populations the sex ratio of adult Harris' Hawks assessed by trapping may be male-biased in some areas (Mader 1979) but not in others (Hamerstrom and Hamerstrom 1978; J. Bednarz, pers. comm.). Among nestlings in Arizona, Mader (1979) reported that the sex ratio was not significantly different from 1:1 (52% male/48% female; $N = 107$, $\chi^2 = 0.23$, $df = 1$, $P > 0.50$). In sharp contrast we find that the sex ratio in captive-bred Harris' Hawks is strongly skewed toward males.

Six breeding pairs of Harris' Hawks (3-12 yrs old and to our knowledge unrelated) composed of active and retired falconry birds were observed for 1-3 yrs. Breeding enclosures and care were as previously described (Coulson and Bradshaw 1982). Egg fertility was determined by candling 7 d after beginning incubation. Pairs were either allowed to hatch and rear their own eggs and young ($N = 27$) or eggs were removed from the nest as laid and incubated artificially ($N = 125$) (see Coulson and Bradshaw 1982). No significant difference in sex ratio of fledglings was found between naturally and artificially incubated eggs. Overall, egg fertility was 89.5% (136/152), hatching success was 89.7% (122/136) of fertile eggs, and 94.3% (115/122) of hatched eggs were fledged successfully. Fledglings recorded as female had body weight which at 70 d exceeded 750 g. Harris' Hawks are highly dimorphic (Hamerstrom and Hamerstrom 1978) and the sexes can be readily distinguished by weight or foot pad measurement (Bednarz 1987).

Of 115 fledglings, 74 (64%) were males and 41 (36%) were females, which differed significantly from a 1:1 ratio ($\chi^2 = 9.5$, $df = 1$, $P < 0.005$). If all eggs hatched but not fledged were female the ratio remains significantly male-biased [74 males (61%)/48 females (39%); $\chi^2 = 5.5$, $df = 1$, $P < 0.05$]. When each of six pairs was examined for male-biased fledgling sex ratio, two showed significant ($P < 0.05$) skewing. None of the pairs produced offspring with a sex ratio significantly different from the overall 64% male/36% female proportion.

Likely, the skewing of sex ratio among Harris' Hawk fledglings reflects an adaptation to social breeding (polyandry and/or male nest helpers) observed in wild Harris'

Hawks. Because nest helpers or extra mates are chiefly male, we propose that Harris' Hawks selectively produce more male offspring to maximize the number of helpers and to increase the likelihood that a related male inherits nesting territory from his parents. A male-biased sex ratio might be fixed genetically or represent a response to environmental factors. In either case an explanation for the discrepancy between captive (male-biased) and wild (unbiased) (Mader 1979) fledgling sex ratio must be found. The survival rate of captive-bred Harris' Hawks is very high, and the "natural" sex ratio set at egg-laying is preserved at fledging. If a male-biased sex ratio is determined genetically, an unbiased fledgling sex ratio in wild Harris' Hawks must be due to differential mortality of male embryos or young, a possibility which can be explored in wild populations. To determine if environmental factors (such as food abundance and quality, proximity of other breeding pairs of Harris' Hawks and availability of nest helpers) influence the fledgling sex ratio, the same parameters can be varied in a captive setting.

We have shown that captive Harris' Hawks produce a preponderance of male offspring. The ability to manipulate the environment of captive pairs of Harris' Hawks and to assess accurately the resulting sex ratio of offspring, free of uncontrolled loss of eggs or young, should help in understanding sex ratio skewing in wild populations.

ACKNOWLEDGMENTS

We wish to thank Jim Bednarz and Mike Braun for many interesting discussions and for access to data prior to publication, and Bill Mader and Dr. Samuel Zeweloff for critical reading of this manuscript. Jerry Fraulini provided sex ratio data for the hawks in his charge. HDB is a Helen Hay Whitney postdoctoral fellow in the laboratory of Milton P. Gordon.

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Received 23 March 1988; accepted 5 October 1988

J. Raptor Res. 22(4):117-118

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EGGS OF THE ORANGE-BREASTED FALCON (*Falco deiroleucus*)

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Earlier, Boyce and Kiff (*Raptor Res.* 15:89-93, 1981) indicated there were probably no authentic egg specimens of the Orange-breasted Falcon (*Falco deiroleucus*) in museum collections. Recently, eggs laid by a captive female Orange-breasted Falcon at The Peregrine Fund, Inc., facility at Cornell University were deposited with the Western Foundation of Vertebrate Zoology (WFVZ), thus enabling a description of the eggs of this poorly studied species.

The female which laid the eggs was taken as a nestling from a site near Tikal, El Peten, Guatemala, in April 1980. The sample includes 3 eggs (WFVZ 140,454) laid in 1983, 4 eggs (WFVZ 150,680) laid in 1984, and 3 eggs from 2 clutches (WFVZ 150,679) laid in 1985 (Fig. 1A).

The eggs are typical of *Falco* in color, having a white ground color and markings of medium brown, reddish-brown and lilac. Markings vary greatly between years, as the clutch laid in 1984 is almost completely suffused with fine medium brown spots, whereas nearly all eggs laid in 1983 and 1985 are more boldly spotted with reddish-brown and lilac (Fig. 1A). The extreme range of variation in the egg markings is of interest, given traditional assumptions of oologists and falconers that particular female falcons tend to lay eggs with consistent markings from one year to the next (e.g., Ratcliffe, D. E., *The Peregrine Falcon*, Buteo Books, Vermillion, South Dakota, 1980). In general Orange-breasted Falcon egg coloration more closely resembles eggs of the Prairie Falcon (*Falco mexicanus*) and Aplomado Falcon (*F. femoralis*) than the generally darker-colored eggs of the Peregrine (*Falco peregrinus*) and Bat Falcon (*F. rufigularis*) (Fig. 1B). The eggs are short subelliptical (7) or subelliptical (3) in shape (Preston *In* Palmer, *Handbook of North American birds*, Vol. 1, Yale Univ. Press, New Haven, Connecticut, 1972).

Average measurements of the sample of 10 eggs are 49.09 (46.71-52.99) × 38.96 (37.07-39.92) mm, and the empty shell weights averaged 0.344 g. Mean eggshell thickness for 10 whole eggshells and 4 additional samples of shell fragments from other eggs laid in 1985 was 0.335 (0.297-0.368) mm. Eggs tended to become shorter (50.60 to 48.97 to 47.73 mm) and broader (38.39 to 38.97 to 39.50 mm) in successive years of laying. Based on egg size and female body weight relationships in the genus *Falco*, Boyce and Kiff (1981) predicted that Orange-breasted Falcon eggs should measure about 48.0 × 37.5 mm with 95% confidence intervals ranging from 44.0 to 52.1 mm (length) and 33.8 to 40.0 mm (breadth). Measurements of Orange-breasted Falcon eggs given here fall close to predicted measurements and within associated 95% confidence intervals, which provides further confirmation that the purported Orange-breasted Falcon egg measurements discussed by Boyce and Kiff (op. cit.) were not authentic.

ACKNOWLEDGMENTS

Tom J. Cade and Willard Heck of The Peregrine Fund, Inc., kindly made the Orange-breasted Falcon eggs available to me, and Clark Sumida of the Western Foundation of Vertebrate Zoology provided the shell thickness measurements and egg photographs. The manuscript was improved greatly by the comments of Douglas Boyce and Clayton White. Support was provided by the Western Foundation of Vertebrate Zoology.

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Received 5 April 1988; accepted 15 September 1988